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INFLUENCE OF GLUCOCORTICOSTEROIDS ON THE STATE OF THE VEGETATIVE NERVOUS SYSTEM DURING ACQUIRED MYOPIA IN SCHOOL AGE CHILDREN

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ABSTRACT

According to research data, the levels of hormones, particularly glucocorticoids and steroids, have a significant impact on the condition of connective tissue. Since the eye's sclera consists of connective tissue, it undergoes changes when the levels of hormones, particularly cortisol, vary. Changes occur in the chemical composition and structural units of the sclera. This occurs due to changes in metabolic processes, in which cortisol is directly involved. It affects the processes of collagen anabolism and catabolism. Collagen is a connective tissue structure of the eye's sclera, which participates in the development of myopia. Also, researchers argue that cortisol levels in children with myopia have a certain effect on the tone of the autonomic nervous system. However, data on this is insufficient. To resolve this issue, this research was conducted. It is necessary to determine the state of the sclera and autonomic nervous system in various levels of cortisol in acquired myopia in children and adolescents, which proceeds without complications.

Key words: myopia, children and adolescents, sclera, cortisol levels, autonomic nervous system.

INTRODUCTION

According to the authors, in research, a significant increase in refraction is observed at the age of 10-14 years old, puberty and pre-puberty [5, 6]. Particularly, Wang and authors (2011) found that the greatest increase in eye length occurs at the maximum intensity of body growth. Probably, such conformity, with hormonal changes occurring during this period. All organisms are capable of hormonal regulation, which is reflected in the activity of metabolic processes and the state of the connective tissue [4]. Glucocorticoids and steroid hormones, such as cortisol, testosterone, and estradiol, directly affect the synthesis and breakdown of collagen and play a key role in supporting these functions. As Balacco C. and Santoro G.

(1978) found, hormonal changes can act as one of the factors influencing connective tissue metabolism, including impaired scleral collagen metabolism in myopia [1, 2]. In fact, the level of glucocorticosteroids have an impact to autonomic nervous system of children with myopia [3].

The aim of the study. The biomechanical properties of the corneoscleral capsule in children and adolescents with various degrees of acquired myopia without complications.

MATERIAL AND METHODS OF RESEARCH

Within the framework of study, the clinical level of cortisol, which is the main hormone that regulates the metabolism of the connective tissue corrosion administered.

Hormonal background analysis was performed by measuring the cortisol concentration in the blood plasma and tear fluid obtained in the morning instead of fasting patients in the traditional method.

RESULTS AND DISCUSSION

During the study conducted under laboratory conditions, it was established that the normal cortisol level in children and adolescents under 17 years of age varies within the range of 83 nmole/L to 580 nmole/L. Based on the analysis of these values cortisol in healthy children and teenagers this made it possible to create referent values for this indicator.

In children with emmetropic refraction, as a result of the administration of the drug cortisol, it was established that the average indicator of cortisol was at the level of 328.3 nmole/L (possible error probability ±50.1 nmole/L).

Table 1.

Cortisol level in blood serum of children and adolescents with various clinical refractions q (nmol/l) (M±m)

Control group	Acquired myopia			High congenital myopia	
	Light	Moderate	Severe	complicated	uncomplicated
328.3	290.7 + 58.6	250.9 + 26.4 *	243.9 + 20.5 *	287.4 + 38.6	413.7+48.8 *

* - reliable differences with control group, p

Due to the fact that vegetative disorders have become widespread among people of different ages, this problem is actual in modern medicine and healthcare. The influence of the autonomic nervous system on the development and course of various diseases can not be overestimated. In some cases, vegetative disorders play the role of the main factor of the pathogen, while in other cases, they arise as a reaction of the body to damage such organs and systems.

In the study, the presence of a correlation between the general and maximal biomechanical problems of the eyes and the state of the vegetative nervous system (VNS) was determined. We agree that myopia develops under the influence of accommodation disorders that are associated with the dysfunction of various parts of nervous system (Volkova E.M., 2006; Zhukova O.V., 2008). A change in the tone of the autonomic nervous system, whether in the form of a sympathetic or parasympathetic reaction, can affect the activity of the accommodation system. This can be manifested in a change in the activity of the vegetative innervation of the ciliary muscle and, as a consequence, in a change in refraction. We used the Kerdo vegetative index (KI), and it is calculated based on the diastolic pressure and heart rate according to the formula: KI= (1-d/p) X100 (here d and p, respectively, mean diastolic pressure and pulse rate). In a complete state of vegetative equility, called eutonia, the KI indicator tends toward zero. If sympathetic influences prevail, the KI indicator is positive, and if parasympathetic influences prevail, it is negative. The zero value of KI is considered vegetative equilibrium (eytonia) q, the negative value is considered an increase in parasympathetic tone (vagotonia), while the positive value is considered an increase in sympathetic effect (sympathicotonia).

During the study, out of 250 students of high school of general education schools (16-17 years old), 87 (in 150 eyes) were diagnosed with myopia, out of 200 children of the same age studying at the lyceum of 100 (194 eyes) were diagnosed with myopia of vary degrees. We conducted a comparative study of the state of vegetative tone in students of high school of secondary schools (87 people) and lyceums (100 people) with vary degrees of myopia. In order to study the relationship between the predominance of tone in the blood and the level of cortisol in the blood, we examined the level of cortisol by taking tears from 50 students of secondary schools and 50 students of senior lyceums with myopia and studying the level of cortisol in them.

Medium-degree myopia was diagnosed in 21 (28%) students, normatonia was detected in 5 (23.8%), vagotonia in 7 (33.4%), and the most common was sympathicotonia, which was detected in 9 (42.8%) adolescents. In these children, the average cortisol level in the morning tear was 430.2+2.4 nmol/l q, moreover, in students with sympathicotonia, high levels were observed (441.5+1.2 nmol/l) (Table 2).

Table 2

Cortisol level (nmol/L) in tears of high school students with myopia

	Light myopia			Moderate myopia			Severe myopia		
VNS type	Normatonia	Vagotonia	Sympatotonia	Normatonia	Vagotonia	Sympatotonia	Normatonia	Vagotonia	Sympatotonia
Cortisol level	400.1±1.2	392.2±0.1	403.1±0.2	432.5±0.4	427.1±1.2	441.5±1.2	539.4±2.1	517.3±1.8	562.2±0.9
Average	402.7±0.9			430.2±2.4			543.9±3.1		

In 17 (19.5%) students of the upper grades of the general education school, a high degree of myopia was diagnosed, and according to the types of vegetative tone, they were distributed at home: normotonia and vagotonia were noted in 5 students (29.4%), and the predominance of sympathetic tone was most often noted in 7 (41.2%) students. In them, the average cortisol level in tears was 543.9+3.1 nmol/lq, which was the highest among adolescents with a predominance of sympathetic VNS (562.2+0.9 nmol/l). As for studies, out of 200 students of senior lyceum classes, 100 (50%) were diagnosed with myopia, of which 32 (32%) had a mild degree of the disease, in turn, 6 (12.5%) had normotonia, 14 (43.7%) had sympathicotonia, hand 12 (37.5%) had vagotonia. The average level of cortisol in the morning tear fluid of students in senior lyceum classes with mild myopia was more balanced than in their peers in general education schools and amounted to 429.3+1.4 nmole/L, while the highest levels of cortisol were found in lyceum students with sympathicotonia (439.5+2.2 nmole/L).

43 (44.25%) pupils of senior lyceum classes were diagnosed with moderate myopia. When studying VT tone, the predominance of students with sympathicotonia was noted in 31 (72.1%), with normotonia in 5 (11.6%), and with vagotonia in 7 (16.3%) adolescents. In these children, the average level of cortisol in the morning tear age was 440.3+1.2 nmole/l, while the highest level was found in students with sympathicotonia uq (452.5+1.2 nmole/l) (Table. 3).

Table 3.

Cortisol level (nmol/L) in tears of senior grade students of an academic lyceum with myopia

	Light myopia			Moderate myopia			Severe myopia		
VNS type	Normatonia	Vagotonia	Sympatotonia	Normatonia	Vagotonia	Sympatotonia	Normatonia	Vagotonia	Sympatotonia
Cortisol level	400.1 ± 1.2	392.2 ± 0.1	403.1 ± 0.2	422.5± 0.4	439.1 ± 1.2	452.5± 1.2	539.4± 2.1	517.3± 1.8	592.5± 0.5
Average	402.7±0.9			440.3±1.2			580.7±1.3		

In 25 (25%) students, fhyfhigh-degree myopia was detectedf, and according to the type of vegetative tone, they were distributed fdomestically: 5 (20%) had fnormatonia, 7 (28%) students had fparasympathetic VAShpredominance, and most often, sympathetic tone was detectedf, and it was detected in 13 adolescents (52%) f. The cortisol level in tears of senior lyceum students with high-degree myopia was 580.7+1.3 nmol/L, and the highest values were noted in sympatotonics (592.5+0.5 nmole/L). With the control grouphahaqaqhaving a statistical significance of 1.4 times was determined ($p<0.05$).

Analysis of the obtained resultshshows that hormonal disorders, hin particular, cortisol metabolism problems, general disorders of the biomechanics of the connective tissue in children and adolescents with developing myopiaqqo'zg'can serve as a predisposing factor, as well as can serve as an indicator of the presence of these disordersqhaq. Ehprobably, under certain conditions, during the child's active growth period, hormonal properties that do not exceed the normqfrom the beginningqom hmay subsequently lead to a disruption of hormonal balance under the influence of certain lifestyle, unbalanced huntingqadvancement, unbalanced physical and spiritual factorsqh, which, in turn, can negatively affect the metabolism of substances in the general bodyhand, as a result, lead to a disruption of the functioning of organs and systems, i.e., become a factor involved in the disruption of the supporting properties of the sclera.

CTR (central thickness of the retina) was studied in the control group, in patients with acquired myopia, there was a tendency to a decrease in corneal thickness (in the control grouph, the average corneal thickness was 553.6±7.1 μmq). In patients with a high degree of acquired myopia, the corneal clearance was significant, $p<0.05$).

The analysis of biometric data in relation to children without pathology, in relation to the axial length of the eye of patients with myopia, due to the extension of the vitreal shell, revealed a significant difference ($p<0.01$). At the same time, during the observation period, ophthalmic-biometric indicators in children with myopia developing of pathology of different parts of VNS were not revealed. Detailed results of echobio-ophthalmometry are presented in Table 4.

Table 4.

Echobiometric parameters of high school students with high-degree myopia according to VNS tone (M±m).

Groups	Front-back dimensions (mm)	Front camera depth (mm)	Crystalline lens (mm)	Keratometry (dptr)
normotony	25.9±1.2	3.2±0.1	3.4±0.2	43.7±1.2
vagotonia	26.9±0.1	3.3±0.6	3.5±1.4	43.1±0.8
sympatotonia	28.1±0.3	3.4±1.5	3.3±0.9	43.5±0.6

Keratometry was performed among associated groups which did not have statistical significance among them ($p > 0.05$). The average thickness of the cornea was 7.78 mm, and ± 0.03 mm, while the average refractive power of the cornea was 43.41 dptr, and probability of error ± 0.15 dptr.

Elongated eyes are characterized by flat cornea (-0.502, $p<0.001$) and enlarged anterior chamber depth (0.651, $p<0.001$). At the same time, there was no significant difference between such parameters as the elongation along axis and the central clearance of the cornea, the rotation of the cornea, the thickness of the anterior chamber and the size of the anterior diameters.

CONCLUSION

In the study 250 students of high school of general education schools, 87 (34.8%) were diagnosed with myopia; of these, 49 (65.3%) had mild myopiaq, and the distribution of vegetative tone types among these adolescents at home was shown: normotonia was diagnosed in 22 (44.8%) students, the predominance of sympathetic tone in 19 (38.7%), and vagotonia was diagnosed in the lowest number of students, that is, in 8 (16.3%) students. The average cortisol level in the morning tear of these children amounted to 402.7±0.9 nmol/L, while there was no reliable difference between students with vegetative tone variations.

As shown by study, in general, the cortisol concentration in patients with myopia corresponds to the age category not taking into account refraction, hand they are within the normal level. However, in comparison with the control group, which was more suitable, a significant tendency towards an increase in the level of this

hormone was revealed, and in adolescents with high-degree myopia, there was a direct presence of VNS tone. In the presence of complicated acquired myopia, the relevance of this factor decreases.

REFERENCES

1. Baird PN, Saw SM, Lanca C, Guggenheim JA, Smith Iii EL, Zhou X, Matsui KO, Wu PC, Sankaridurg P, Chia A, Rosman M, Lamoureux EL, Man R, He M. Myopia. Nat Rev Dis Primers. 2020 Dec 17;6(1):99. doi: 10.1038/s41572-020-00231-4. PMID: 33328468.

2. Balacco-Gabrieli C, Mastrandea G, Acquafredda A, Stefania O, Ciufreda A, Cavallo L. Congenital cataract and evolutive myopia. Relationship with hypophyseal-adrenal cortical axis function. Ophthalmic Paediatr Genet. 1986 Mar;7(1):63-7. doi: 10.3109/13816818609058043. PMID: 3010210.

3. Bremond-Gignac D. Myopie de l'enfant [Myopia in children]. Med Sci (Paris). 2020 Aug-Sep;36(8-9):763-768. French. doi: 10.1051/medsci/2020131. Epub 2020 Aug 21. PMID: 32821053.

4. Chou T, Huang X, Liu J, Liu X, Zeng K, Yan Z, Mei S, Sun L, Xi W, Ni J, Zi J, Zhao J, Liu S. First Evidence Indicates the Physiology- and Axial-Myopia-Dependent Profiles of Steroid Hormones in Aqueous Humor. Metabolites. 2022 Dec 5;12(12):1220. doi: 10.3390/metabo12121220. PMID: 36557258; PMCID: PMC9787499.

5. Flitcroft DI, He M, Jonas JB, Jong M, Naidoo K, Ohno-Matsui K, Rahi J, Resnikoff S, Vitale S, Yannuzzi L. IMI - Defining and Classifying Myopia: A Proposed Set of Standards for Clinical and Epidemiologic Studies. Invest Ophthalmol Vis Sci. 2019 Feb 28;60(3):M20-M30. doi: 10.1167/iovs.18-25957. Erratum in: Invest Ophthalmol Vis Sci. 2024 Nov 4;65(13):19. doi: 10.1167/iovs.65.13.19. PMID: 30817826; PMCID: PMC6735818.

6. Iomdina E, Tarutta E, Markossian G, Aksenova J, Smirnova T, Bedretdinov A. Sclera as the target tissue in progressive myopia. Pomeranian J Life Sci. 2015;61(2):146-52. doi: 10.21164/pomjlifesci.69. PMID: 27141597.

7. McDougal DH, Gamlin PD. Autonomic control of the eye. Compr Physiol. 2015 Jan;5(1):439-73. doi: 10.1002/cphy.c140014. PMID: 25589275; PMCID: PMC4919817.

8. Ojha RK, Singh R, Maurya O, Agrawal JK. Myopia and plasma cortisol. Indian J Ophthalmol. 1989 Apr-Jun;37(2):91-3. PMID: 2583791.